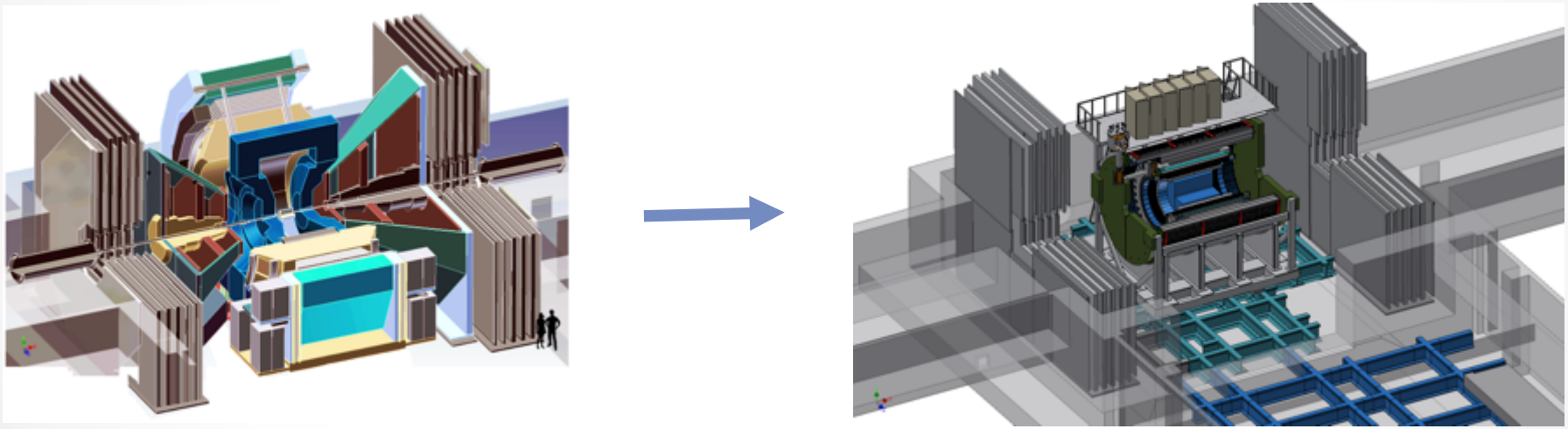
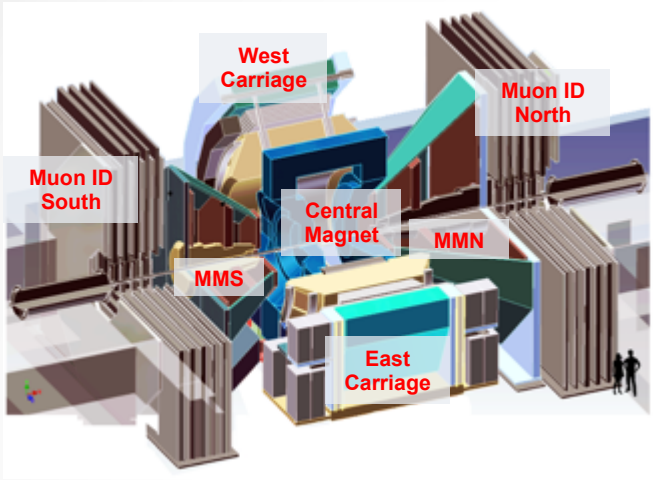
Decommissioning PHENIX and sPHENIX Installation and Integration



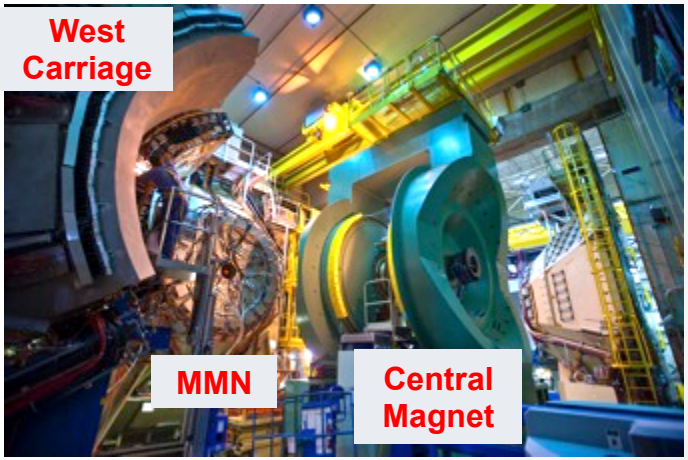
Director's Cost and Schedule Review

November 9-10, 2015

Decommissioning Specifications/Requirements



- Remove and disposition all PHENIX carriages: East Carriage (EC), West Carriage (WC), North and South Muon Magnets (MMN & MMS) and Central Magnet (CM) and all PHENIX detector subsystems and services comprising, salvage high value components
- Cap off PHENIX gas system supply piping for future use
- Re-use as much Infrastructure as possible
- Retain shield walls, moveable and permanent and Muon Identifier (MuID) Steel
- Remove PHENIX Current beampipe, replace with temporary beampipe for run 17 and RHIC Energy Scan runs



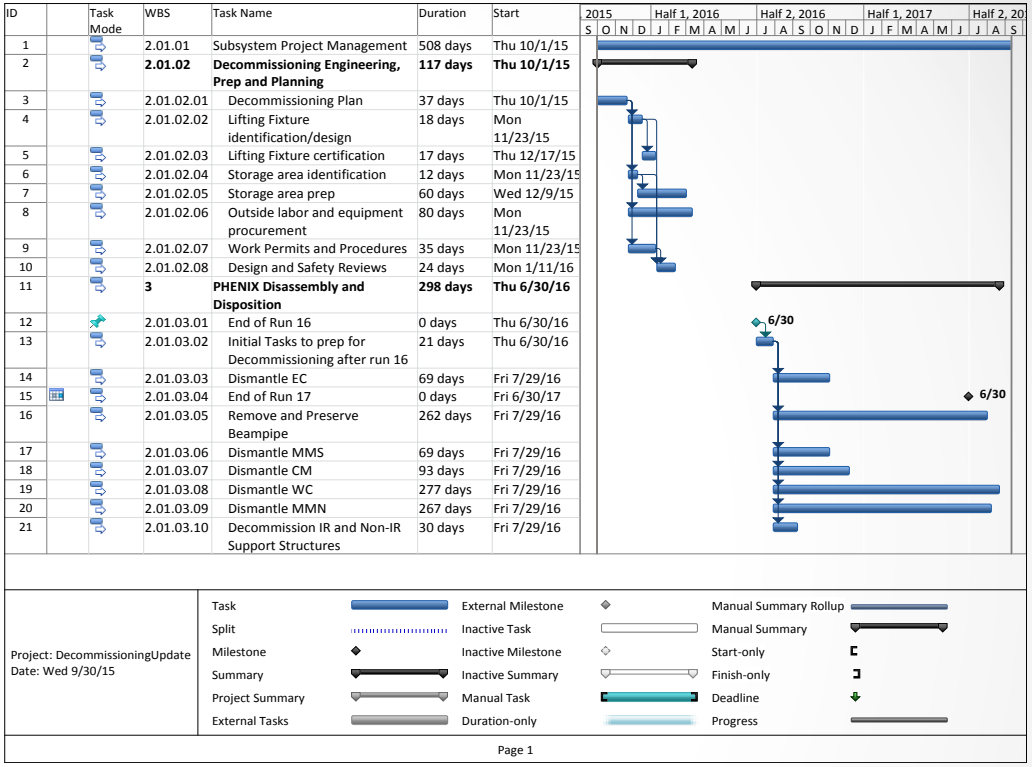
Decommissioning Description

- **Obtain permission to Decommission PHENIX**
- **Prepare for Decommissioning**: work plans, determine disposition of Non-PHENIX/DOE equipment, re-certify lifting fixtures, contracts for disassembly and disposal, Set up work/ storage space for salvage parts
- **Initial Tasks**: Purge, disconnect, remove collars, move South Magnet (MMS) south, move EC to Assembly Hall (AH), start beampipe removal
- **Disassembly and Disposition**: For each major segment of PHENIX (EC,), strip off services, remove racks, remove & dispose detector subassemblies, disassemble and dispose of frames, structural supports, access and platforms
- **Other** : Strip back and cap off services, decommission in place Infrastructure systems to be (or potentially to be) modified in the future Muon Identifier steel and detector panels, remove beampipe sections to safe storage for later modification and installation in sPHENIX. Install temporary beampipe and supports for Run 17 and Energy Scan runs.

Decommissioning Schedule and Resource Requirements

4/3/16	Approval to Decommission
6/30/16	End of Run 16/ begin Decommissioning
1/1/17	run 17 Begins, IR is closed for run
6/30/17	Run 17 ends
1/1/18	Decommissioning complete

Duration:	21	Months
Scientist:	0.15	FTE
Engineer:	0.80	FTE
Designer:	0.04	FTE
Technician:	1.98	FTE
Trades:	0.83	FTE
Purchased Materials, rented equipment and outside labor	$244,000	



ID	Task Mode	WBS	Task Name	Duration	Start
1		2.01.01	Subsystem Project Management	508 days	Thu 10/1/15
2		**2.01.02**	**Decommissioning Engineering, Prep and Planning**	**117 days**	**Thu 10/1/15**
3		2.01.02.01	Decommissioning Plan	37 days	Thu 10/1/15
4		2.01.02.02	Lifting Fixture identification/design	18 days	Mon 11/23/15
5		2.01.02.03	Lifting Fixture certification	17 days	Thu 12/17/15
6		2.01.02.04	Storage area identification	12 days	Mon 11/23/15
7		2.01.02.05	Storage area prep	60 days	Wed 12/9/15
8		2.01.02.06	Outside labor and equipment procurement	80 days	Mon 11/23/15
9		2.01.02.07	Work Permits and Procedures	35 days	Mon 11/23/15
10		2.01.02.08	Design and Safety Reviews	24 days	Mon 1/11/16
11		**3**	**PHENIX Disassembly and Disposition**	**298 days**	**Thu 6/30/16**
12		2.01.03.01	End of Run 16	0 days	Thu 6/30/16
13		2.01.03.02	Initial Tasks to prep for Decommissioning after run 16	21 days	Thu 6/30/16
14		2.01.03.03	Dismantle EC	69 days	Fri 7/29/16
15		2.01.03.04	End of Run 17	0 days	Fri 6/30/17
16		2.01.03.05	Remove and Preserve Beampipe	262 days	Fri 7/29/16
17		2.01.03.06	Dismantle MMS	69 days	Fri 7/29/16
18		2.01.03.07	Dismantle CM	93 days	Fri 7/29/16
19		2.01.03.08	Dismantle WC	277 days	Fri 7/29/16
20		2.01.03.09	Dismantle MMN	267 days	Fri 7/29/16
21		2.01.03.10	Decommission IR and Non-IR Support Structures	30 days	Fri 7/29/16

Note: Schedule is most optimistic: assumes enough manpower available to do all tasks in parallel, wherever possible. Tasks are appropriately linked but not resource leveled.

Decommissioning Cost and Schedule Drivers

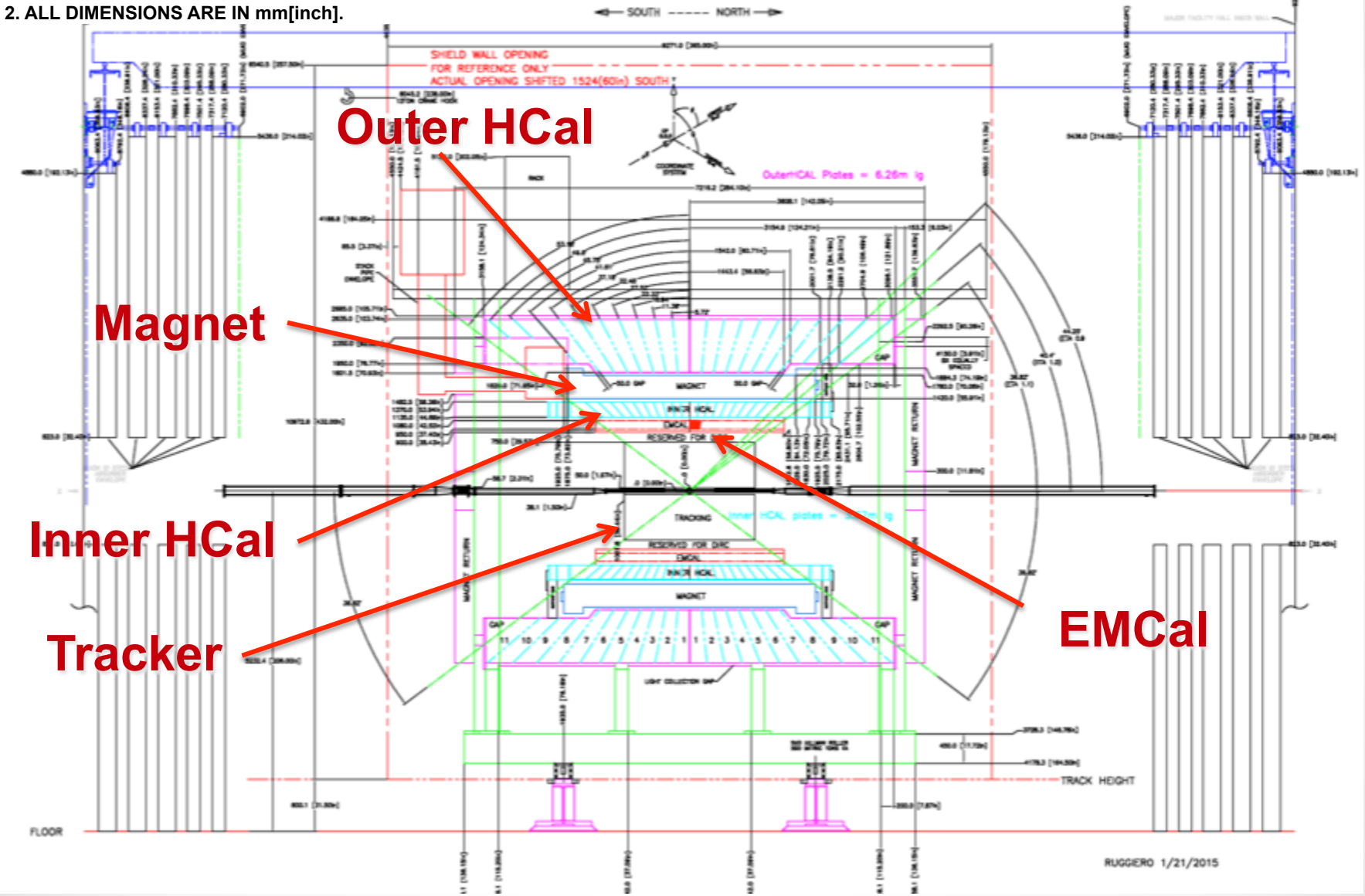
- **Major Cost Drivers**
  - Lifting Fixture refurbishment/replacement
  - Storage area prep/infrastructure
  - Purchased services and rental equipment (cranes) for structural disassembly
  - Technician Labor
- **Major Schedule Drivers**
  - Approval to decommission
  - Availability of technician support
  - Run 16 schedule
  - Run 17 schedule
  - Availability of purchased labor/services

Specifications/Requirements: sPHENIX Integration and Installation

- **Integration**
  - All components assembled onto a single support carriage
  - Carriage supports Outer HCal, Flux return end caps, access and service platforms
  - Outer HCal supports Magnet, Inner HCal and Tracker, independently
  - Inner HC supports EMCal
  - 50 mm gap between detectors for clearance and installation
- **Installation**
  - IR & AH Floor Loading Limits: 4000 psi, max
  - Positional precision: 0.5 mm,
    Angular precision: 10 milliradian (roll, pitch and yaw)
  - Installation to be accomplished in the Assembly Hall (40 ton and 5 ton overhead cranes)
  - Assembly to be prepared for magnet mapping in Interaction Region (IR) after Outer HCal is installed, then returned to Assembly Hall to complete detector installations.
  - Overall size requirements The complete sPHENIX assembly, including magnet valve box stack and all electronics racks, must fit through the sPHENIX sill on the existing sPHENIX rail system

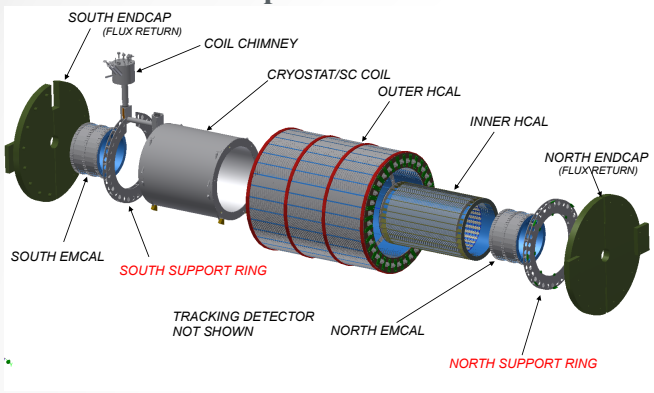
SPHENIX ENVELOPE DRAWING

NOTES:
1. NOTED DIMENSIONS ARE MAXIMUM SIZE.
   ALL SERVICES, NUTS, BOLTS & OTHER DETECTOR
   COMPONENTS SHALL NOT EXCEED THESE DIMENSIONS.
2. **ALL DIMENSIONS ARE IN mm[inch].**



Integration and Installation Design

Detector Major Components Exploded View



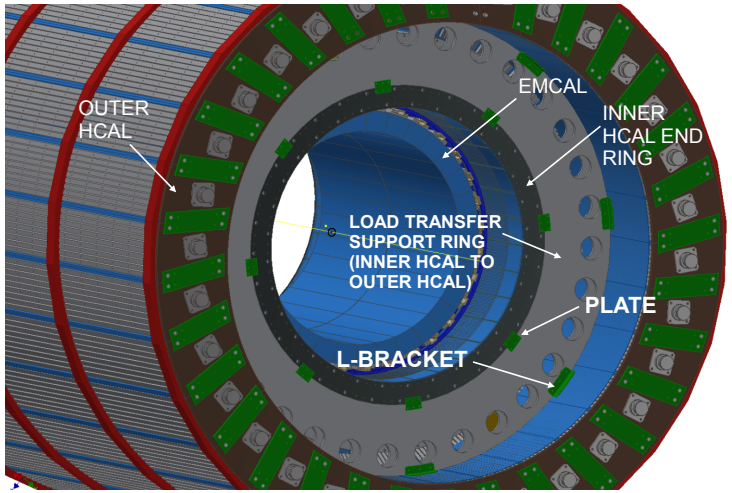
Integration & Installation Design Drivers:

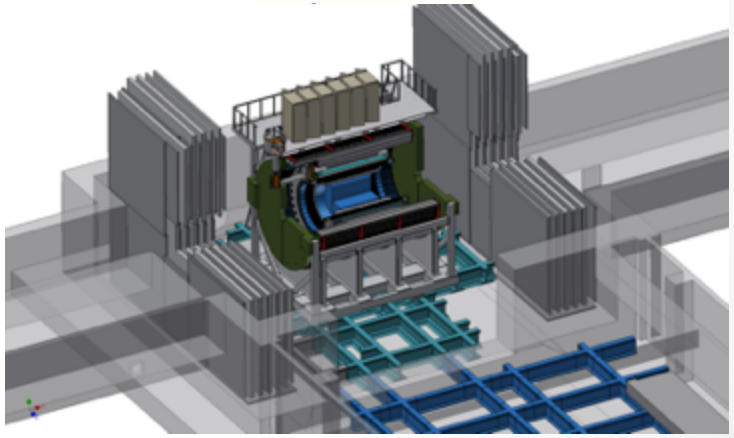
- Subsystem Design
- Existing Infrastructure (shield wall opening, Crane coverage and limits, rail layout)
- Minimum material in active areas
- Access for repair, maintenance, upgrade
- Safety

- (Future upgrade capability)

Inner HCal ½ sector Class II mockup
(dimensionally accurate/non-functional)

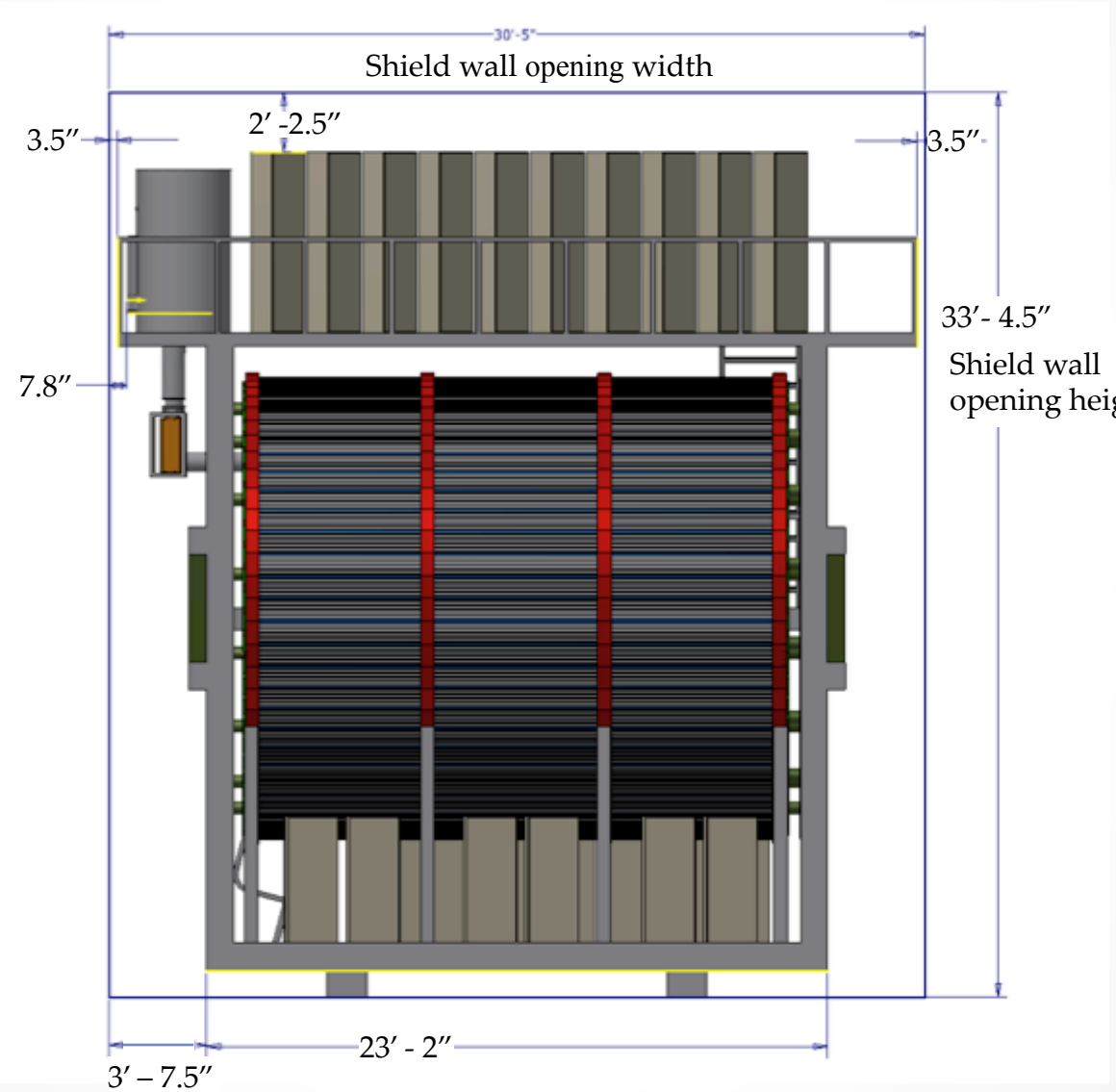
Load Path from Inner detectors to Outer HCal



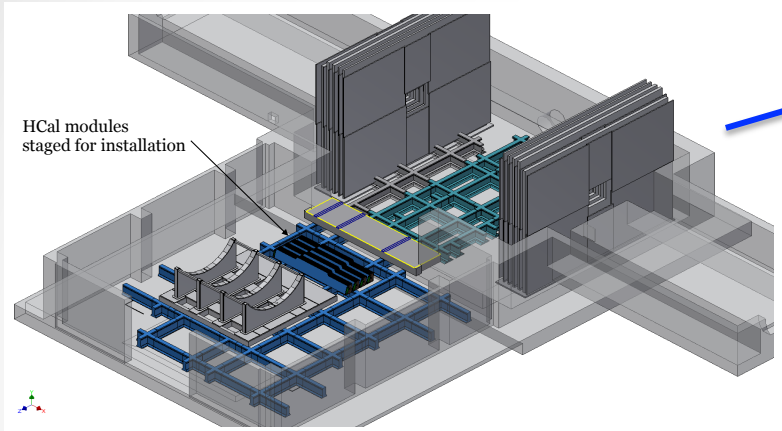


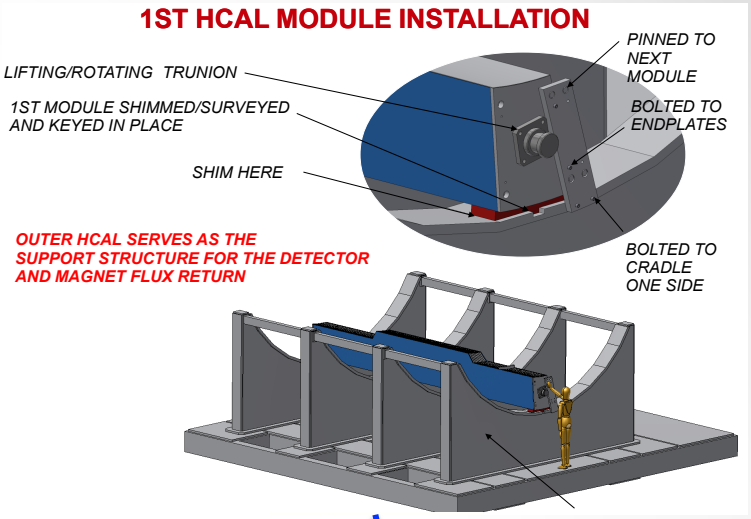
sPHENIX Full Assembly Ready for service: Cutaway View

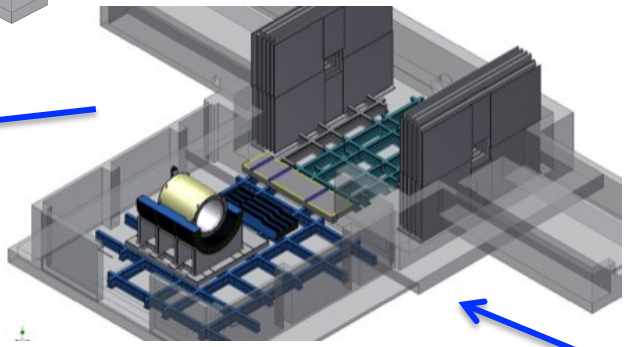
sPHENIX Overall Size and Shield Wall Opening



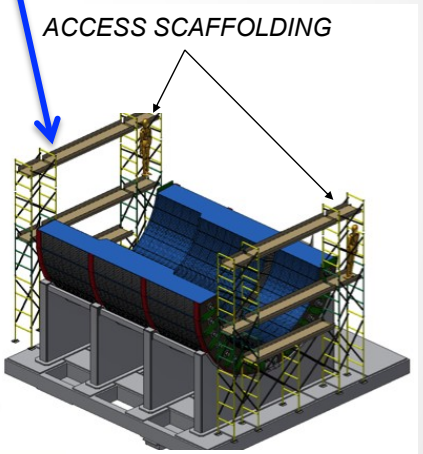
Installation Sequence

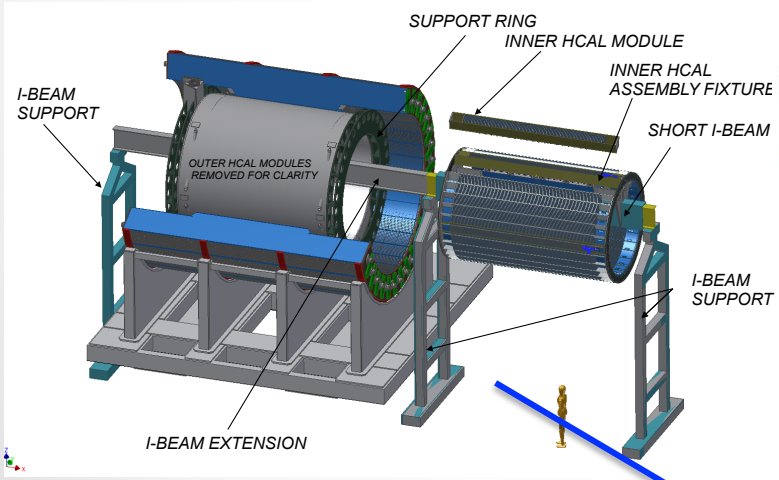


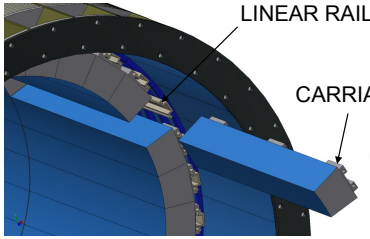




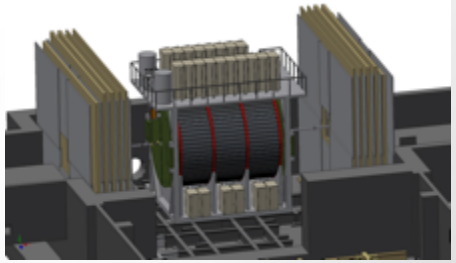
Magnet mapping before Inner HCal Installation







Tracker Installation



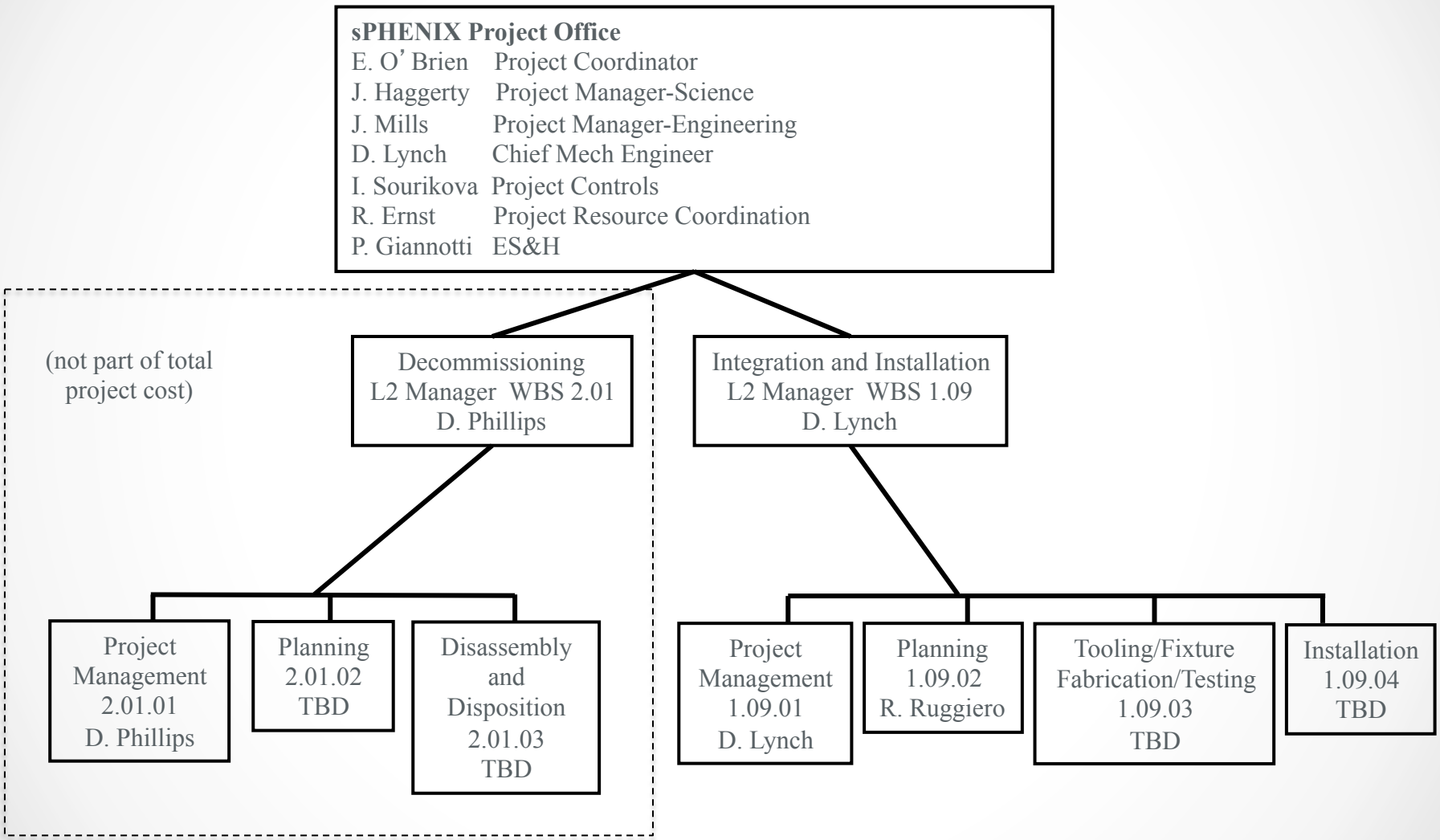
Integration and Installation Cost and Schedule Drivers

- **Major Cost Drivers** (Does not include detector sections and equipment produced as part of detector subsystems [e.g. handling fixtures])
  - Assembly, holding and lifting fixtures particularly the Outer HCal indexed lifting fixture, the Inner HCal assembly and installation fixtures, and the EMCal indexed lifting fixture
  - Alignment/ survey fixtures
  - Scaffolding and temporary Hcal internal support structures
  - (Note: cost of carriage and structural support integration components is in the infrastructure subsystem
  - Technician Labor

- **Major Schedule Drivers**

  - Infrastructure completion (which in turn is dependent on decommissioning completion)
  - Delivery of carriage components and internal structural support components
  - Delivery of Outer HCal sectors, Magnet, Inner Hcal, EMCal and Tracker sections
  - Magnet mapping
  - Commissioning

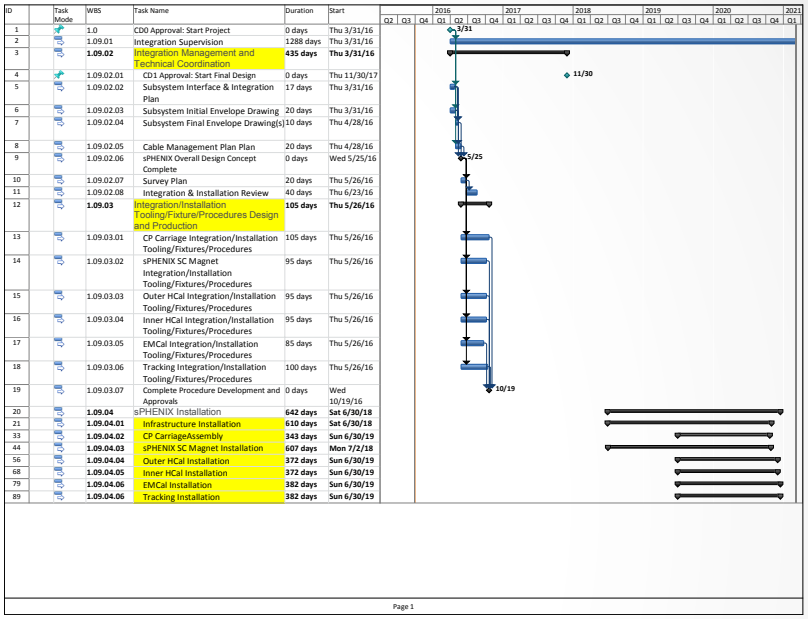
Decommissioning, Installation and Integration Organization



Installation Schedule and resource Requirements

Key Dates

1/1/18	Decommissioning of PHENIX complete
1/1/19	Funds available to procure base components
9/1/19	Base components ready for assembly
4/1/20	Magnetic measurements/mapping
9/1/20	Installation, sPHENIX complete ready for commissioning



ID	Task Mode	WBS	Task Name	Duration	Start
1		1.0	CD0 Approval: Start Project	0 days	Thu 3/31/16
2		1.09.01	Integration Supervision	1288 days	Thu 3/31/16
3		**1.09.02**	Integration Management and Technical Coordination	**435 days**	**Thu 3/31/16**
4		1.09.02.01	CD1 Approval: Start Final Design	0 days	Thu 11/30/17
5		1.09.02.02	Subsystem Interface & Integration Plan	17 days	Thu 3/31/16
6		1.09.02.03	Subsystem Initial Envelope Drawing	20 days	Thu 3/31/16
7		1.09.02.04	Subsystem Final Envelope Drawing(s)	10 days	Thu 4/28/16
8		1.09.02.05	Cable Management Plan Plan	20 days	Thu 4/28/16
9		1.09.02.06	sPHENIX Overall Design Concept Complete	0 days	Wed 5/25/16
10		1.09.02.07	Survey Plan	20 days	Thu 5/26/16
11		1.09.02.08	Integration & Installation Review	40 days	Thu 6/23/16
12		**1.09.03**	Integration/Installation Tooling/Fixture/Procedures Design and Production	**105 days**	**Thu 5/26/16**
13		1.09.03.01	CP Carriage Integration/Installation Tooling/Fixtures/Procedures	105 days	Thu 5/26/16
14		1.09.03.02	sPHENIX SC Magnet Integration/Installation Tooling/Fixtures/Procedures	95 days	Thu 5/26/16
15		1.09.03.03	Outer HCal Integration/Installation Tooling/Fixtures/Procedures	95 days	Thu 5/26/16
16		1.09.03.04	Inner HCal Integration/Installation Tooling/Fixtures/Procedures	95 days	Thu 5/26/16
17		1.09.03.05	EMCal Integration/Installation Tooling/Fixtures/Procedures	85 days	Thu 5/26/16
18		1.09.03.06	Tracking Integration/Installation Tooling/Fixtures/Procedures	100 days	Thu 5/26/16
19		1.09.03.07	Complete Procedure Development and Approvals	0 days	Wed 10/19/16
20		**1.09.04**	sPHENIX Installation	**642 days**	**Sat 6/30/18**
21		**1.09.04.01**	Infrastructure Installation	**610 days**	**Sat 6/30/18**
33		**1.09.04.02**	CP CarriageAssembly	**343 days**	**Sun 6/30/19**
44		**1.09.04.03**	sPHENIX SC Magnet Installation	**607 days**	**Mon 7/2/18**
56		**1.09.04.04**	Outer HCal Installation	**372 days**	**Sun 6/30/19**
68		**1.09.04.05**	Inner HCal Installation	**372 days**	**Sun 6/30/19**
79		**1.09.04.06**	EMCal Installation	**382 days**	**Sun 6/30/19**
89		**1.09.04.06**	Tracking Installation	**382 days**	**Sun 6/30/19**

Duration:	1288	Days	
Scientist:	0.32		FTE
Engineer:	0.67		FTE
Designer:	0.18	FTE	
Technician:	0.94	FTE	
Trades:	0.56		FTE
Purchased materials, equipment and supplies		$310,000	

Decommissioning, Installation and Integration Technical Status

- **Decommissioning –**
  - Need approval to decommission
  - All requirements known, ready to begin planning and preparation
  - Collection and evaluation of existing subsystem lifting and handling fixtures in progress
- **Integration and Installation**
  - Pre-Conceptual Design is evolving in parallel with detector subsystem design
  - Ongoing structural analyses (FEA) to test adequacy of integration/ structural support concepts
  - Evaluation of purchased component procurement tradeoffs in progress
  - Evaluation of cost and schedule sequence tradeoffs in progress
  - Evaluation of competing installation fixturing design tradeoffs in progress

Alternatives Considered

- **Decommissioning**
  - salvage vs. bulk recycle– *high value items requiring minimal additional efforts to be salvaged all else to be bulk recycled*
  - Cutting large MMN components in IR vs bringing in large crane and hauling out large MMN pieces *– cutting in IR is more cost effective*
  - removing Muld Steel vs retaining *– retaining eliminates costly removal and provides background shielding for sPHENIX detectors*
- **Integration and Installation**
  - Support base: multiple carriages vs single carriage *– Single carriage more cost effective easier to align*
  - Pole Tips: separate structural support vs common support with magnet; sliding (horizontal and vertical flux return end caps vs hinged) *– hinged is safer, less cost*
  - EMCal assembly: independent support structure for entire detector vs rails on Inner Hcal for each sector *– rails is less cost and less material in active areas*
  - Magnet Stack: Opening in middle of Outer HCal vs extension to move valve box out of active area *– Extension maintains greater uniformity in Outer Hcal, simpler less costly design*
  - Magnet test: in Assembly Hall (AH) vs in Interaction Region (IR) *– In IR is less complicated does not require duplication/relocation of infrastructure*
  - Inner HCal Installation Fixture - *several options being evaluated*
  - Inner HCal Assembly away from AH then transported to AH for installation vs. assembly and installation in AH *– assembly in AH is less complex and does not require additional assemly facilities and infrastructure*
  - Overall assembly in IR vs AH *– assemble in AH, Crane loadings in IR too low, less space to work*

Decommissioning, Integration and Installation Issues and Concerns

- **Decommissioning**
  - Activation of steel
  - Disassembly of the MMN in the IR
  - Disassembly of the CM in the AH: Central magnet components exceed 1008 crane capacity
  - Final disposition of scrapped materials
  - In-house vs. outside contractors for disassembly of large structures

- **Integration and Installation**
  - Alignment tolerances for individual detector subsystems – Is precision specification appropriate
  - Magnet mounting & alignment
    - intrinsic to magnet: adapting SLAC mounting feet to sPHENIX Outer Hcal
    - Field calculation to determine acceptable tolerances
  - Magnet Mapping: do we need Inner HCal installed?
  - Details of Inner HCal installation fixture design
    - Operation (rotating locking clutch, safety considerations)
    - Design of beam for installing complete
  - EMCal alignment provisions
  - Tracker assembly design details
    - What are alignment requirements?, Install before or after beampipe?, Install as a unit or in sections?